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Relationship of Caffeine Content in Energy Drinks to Health in High School and College-Aged Adolescents

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Introduction

As a typical American teenager attending high school or a university, it is quite common to stay up late at night finishing up homework assignments, or cramming for tests. Due to a lack of sleep for several consecutive nights, students are unable to muster up the energy needed to make it through one more night. Thus, they turn to a form of false energy, which presents itself in colorful, highly priced, calorie-packed cans, filled with the perfect amounts of caffeine and sugar to keep them awake at night. These sources of false energy beverages are widely known to the world as "energy drinks. Energy drinks are beverages that contain caffeine, taurine, vitamins, herbal supplements, and sugar or sweeteners and are marketed for a number of reasons, mainly pinpointing boosts in energy, furthering weight loss, and also increasing stamina, athletic performance, and concentration. Available in more than 140 countries around the world and as the fastest growing U.S. beverage market, sales are expected to top $9 billion in 2012. Red Bull, Monster, Full Throttle, Amp, XS, Redline, Rockstar, and Spark are few among the many energy drinks that exist in the beverage market today. Half of the energy drink consumer market consists of children less than 12 years of age, adolescents between 12 and 18 years of age, and young adults, between 19 and 25 years.

Purpose

The real question is why energy drink consumption is so rampant when there are an abundance of case studies establishing the harm related to specifically energy drink consumption. The problem is that our society has not been trained to look into and beyond nutrition labels, or to view the long-term consequences of an action. Furthermore, people have not been encouraged to look into additives listed under (and sometimes not listed under) the "Additional Ingredients" below a nutrition label (Nutrition Data). As energy drinks are currently not regulated by the Food and Drug Administration (FDA), what is the reason for concern? High concentrations of caffeine (from 70 to 80 mg per 8 ounce serving) in energy drinks, especially in comparison to drinks such as sodas and coffee, pose a potential threat to health. Caffeine, especially when consumed in quantities over 70 to 100 mg, can lead to more serious conditions including cardiac conditions, changes in different types of muscle tissue, muscle stimulation and relaxation, insulin sensitivity, and differences in gene expressions. Further regulation is a must, as research into the association of energy drink consumption and physical health can be attributed to specific ingredients found in these energy drinks, namely caffeine.
The Food and Drug Administration (FDA) should have regulations that prohibit the sale of these over-caffeinated drinks to individuals under the age of 18. In addition, the FDA should require explicit labeling of these products (as is currently done so for alcoholic beverages and cigarettes) so that the user is both warned of the dangers of high levels of caffeine and of the additives that amplify the effect of caffeine, in order to ensure that the user knows the actual dosage of caffeine contained in the product.

Ingredients of Energy Drinks: Caffeine Alone and in Combinations

Caffeine and its relationship with other additives in energy drinks such as sugars, taurine, D-glucurono, carbohydrates, B vitamins, and amino acids can amplify and enhance the individual effects of the ingredients

- Taurine:
  - Not a clear distinction between amount of taurine necessary for survival and that taken in excess
  - Possible fluctuations in heart rate, plasma catecholamines, and endurance changes
- Glucose & D-glucorono:
  - Glucose alone slowed reaction time
  - Glucose + caffeine enhanced working memory
  - Glucose + taurine enhanced orienting attention
- Vitamin B6:
  - Discrepancy between existing values and those found using the High-Performance Liquid Chromatography (HPLC) method

Probability for error:

- Different energy drinks may contain different concentrations of ingredients, which can also influence the direct affects associated with consumption
- Finding *individual ingredients'* correlation to health effects because these individual ingredients interact with each other. Thus it is incomplete to only discuss caffeine when finding a correlation between its consumption in energy drinks and physical health, as caffeine's effect is amplified due to the additives taurine, D-glucurono and glucose, and B Vitamins

Therefore, studies have detailed that though ingredients found in energy drinks such as caffeine, taurine, vitamin B6, carbohydrates, amino acids, and herbal supplements may be present in varying quantities and concentrations, they all have a significant effect on the health of any given consumer and little to no therapeutic benefit. While they may not be as harmful alone, the additives found in energy drinks on top of caffeine serve to enhance and amplify the risk of energy drink consumption.

The Energy Epidemic: Energy Drinks and General Health Issues

Caffeine has been pinpointed as the primary cause of cardiovascular, renal, or liver disease, seizures, diabetes, mood and behavioral disorders, and/or hyperthyroidism associated with overconsumption. Long term consumption of caffeine prolongs half-life and thus increases the negative affects of caffeine and chances of severity of a given condition. This may include "disorganized atrial activity." Possible risk factors associated with energy drink consumption include:

- palpitation
- atrial fibrillation
- cardiac arrhythmias
- dyspnea
- fatigue
- light-headedness
- syncope (unconsciousness)
- increase in blood pressure
- fluctuating blood glucose levels
- changes in BMI
- calcium deficiency
- dental problems
- depression, low self-esteem issues

Such conditions are determinate on a variety of factors, all of which contribute to the idea of energy drink consumption as a method of "self-intended poisoning." This variety of factors, otherwise known as risk factors, associated with consumption are determinate on age, sex, body height, body mass index (BMI), systolic pressure, and treatment for hypertension (high blood pressure).

An Approach from a Different Aspect: Case Studies Involving Non-Humans

The lack of control resulting from the general diversity of the population being tested makes such studies conducted on non-human species more valuable and the evaluations more accurate.

According to various case studies that discuss experiments performed on human-like species such as rats and dogs, caffeine, taurine, and D-glucurono, relationships can be found between the different ingredients in energy drinks to determine if there is a significant correlation to consistent behavioral or cognitive effects, such as growth retardation and increases in malformations during pregnancy, changes in blood pressure, differences in plasma concentration of the growth hormone, or even low blood sugar in young children. However, as is evident by the following research findings, not all correlations found can be absolutely correct and justified.

- "Study in primates has shown caffeine exposure to be associated with increased still births, miscarriages, reduced birth weight and impaired postnatal performance in a [behavioral] task"
  - Disadvantage to this study: only a minority of children and adolescents are pregnant
- "While one "canine trial demonstrated an increase in cardiac arrhythmias with high doses of caffeine administered," another study demonstrated that "escalating doses of caffeine in dogs surprisingly found that serum caffeine actually decreased the propensity for atrial fibrillation"
  - These cases contradict each other, thus the validity of such non-human case studies is called into questions

Overview: The Future of Energy Drinks and the Importance of Research and Regulation

As energy drinks are not FDA regulated, there is a pervasive concern that energy drinks are not adequately researched and are unregulated. It would be wise for the FDA to have regulations and prohibit the sales of energy drinks to those under a set age of 18, just as a drinking and buying age for alcohol is set at 21. Additionally, if the explicit labeling of energy drinks was enforced, consumers would not only be more aware of what they are putting in their bodies, but would be also warned of the possible risks associated with the consumption of certain ingredients, namely caffeine, in these drinks.

- **Problem:** FDA recognizes that "the additive or synergistic effects of certain ingredients should be of concern," yet they said that on average, energy drinks contain "about 300mg of caffeine," which is under the "400 mg per day limit that FDA has said is not associated with adverse effects in healthy adults"
  - **Solution:** FDA needs to highlight that though 300 mg is under the 400 mg limit, the additives *amplify* the affect of this 300 mg.
- **Problem:** Studies that discuss the nature of consumption and call into question whether the risks do indeed outweigh the benefits of consumption. They are not asking to be refuted, but only to be supported by further information on "caffeine, herbal extract . . . ribose," the ingredients that have been proven or not yet proven to have some form of negative impact on the health due to their presence in energy drinks. → Though the source of health influences has been found, the lack of conclusive studies available to the general energy drink consuming population may force one to stop short.

Possible Solutions:

- The advertising campaign can become more regulated
  - Prevent portraying energy drinks as positive sources of energy on billboards, vending machines, common chain stores (e.g. 711)
- Evaluate importance of long-term research objectives
  - Spreading awareness in a way that enforces people to physically take caution prior to consumption
  - Making people not only aware, but also care

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